Purpose: To study the dose deposited during radiosynoviorthesis by radionuclides carried by stochastically migrating macrophages in arthritic joints and to estimate both the activity that would deposit 100 Gy at the prescription point in the tissue and the resulting dose-volume histograms. Currently, Re-186 and Er-169 are used for medium and small joints respectively while Sn-117m is under investigation.

Methods: The GATE Monte Carlo software was used to simulate the dose from 6 μm diameter radioactive particles moving randomly with uniform, Lorentzian or Lévy distributions of the velocity. Twenty half-lives of Sn-117m, Er-169 and Re-186 were simulated in a synovial joint model adopted from the dissertation of LS Johnson. A dose profile as a function of depth, administered activity relative to 1 MBq/cm² of Sn-117m, activity as a function of depth to deposit 100 Gy at the prescription depth, and dose-volume histograms were studied.

Results: The administered activity relative to 1 MBq/cm² of Sn-117m was calculated to be 1.60, 1.60, and 2.077 MBq/cm² of Er-169; and; 2.10, 2.10, and 8.51 MBq/cm² of Re-186; for the uniform, Lorentzian, and Lévy distributions respectively. The activity required to deposit 100 Gy at a depth of 0.5 mm from the synovial surface was estimated to be 0.413, 0.413, and 40.2 MBq/cm² of Sn-117m; 0.917, 0.917, and 28.7 MBq/cm² of Er-169; and 1.28, 1.28, and 1.78 MBq/cm² of Re-186 for the three velocity distributions.

Conclusion: Sn-117m could replace Er-169 and Re-186 in the radiosynoviorthesis of medium and small-sized joints respectively.